

Solid Phase Microextraction of Anions of Environmental
Interest: Applications of Conducting Polymer Microfiber
Electrodes for Injection System for HPLC and FIA
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Solid Phase Microextraction (SPME) using silica and bonded phase fiber membranes has been the subject of investigation by a number of groups for preconcentration of anionic analytes for analysis by ICP-MS or HPLC/ICP-MS. Although they have proven useful in some circumstances, they suffer from three major disadvantages—namely the necessity for derivatization of the surface to accomplish adsorption, the length of time required for the preconcentration and release steps of the analysis, and possibilities of fouling by matrix components. At present, we are investigating the possibility of using poly-3-methylthiophene and other conducting polymer microfiber electrodes for uptake of anions of chromium, arsenic, etc. from aqueous solution. Our efforts have focused on these anions due to the importance of developing sensitive assays for the various species present in environmental samples. After fabrication of the conducting polymer on a platinum microfiber substrate by cycling in a nonaqueous solution of the monomer, the polymer is immersed in the sample solution and converted to its positively charged form by application of a potential of an oxidizing potential. The anions of interest then migrate into the polymer to preserve electroneutrality. Upon reversal of the potential to negative values, the polymer is converted back to its neutral hydrophobic form and the ions are expelled. The concentration procedure normally requires less than 10 to 30 sec and desorption is complete in less than 1 to 2 sec. The typical time requirements are an hour or more for the conventional microfiber extraction. The redox potentials (and electron transfer kinetics) of the polymer must be chosen so that the valence states of these species in the environment does not change on uptake and release. Detection of picogram quantities of these anions are routinely possible and optimization of polymer formation, extraction and desorption potentials and times promise even lower detection limits. In addition, such polymer electrodes have been shown in prior studies not to be subject to fouling even in solutions containing high concentrations of proteins or surfactants. The electrode system has been designed to permit direct injection into HPLC and FIA instruments. This device, is thus, the electrochemical analog of the conventional hypodermic syringe as an injection device for flow systems. Extension of the system has been extended to the uptake of cations and neutrals of environmental interest.